Outline of Mechanical and Magnetic Measurements during FNAL LHC Production

1st draft, jsk, 17 September, 1999

- As a completed cold mass, after yoke and skin are welded on, mechanical measurements of the twist of the cold mass are taken. These are continuous along the length of the cold mass.
- As a completed cold mass, warm magnetic measurements can be taken, and can be cross-referenced with the mechanical measurements.
    - These two measurements can be used to determine the placement of the cold mass to cryostat positioning lugs.

- As a cryostated assembly, warm measurements are taken which reference the magnetic axis to fiducials on the outside of the cryostat.
- During cold test, the stretched wire system allows the measurement of the magnetic axis directly to the references on the outside of the cryostat.
- After cold test, warm measurements of the magnetic axis can be taken again, using the same stretched wire system as the cold test, to confirm the magnetic axis to the external references.

Comments on Straightness and Twist Expected in MQXB Cold Masses

1st draft, jsk, 22 September, 1999

Straightness

To measureable levels, we expect the ~6m cold mass of the MQXB to be straight. I base this on:

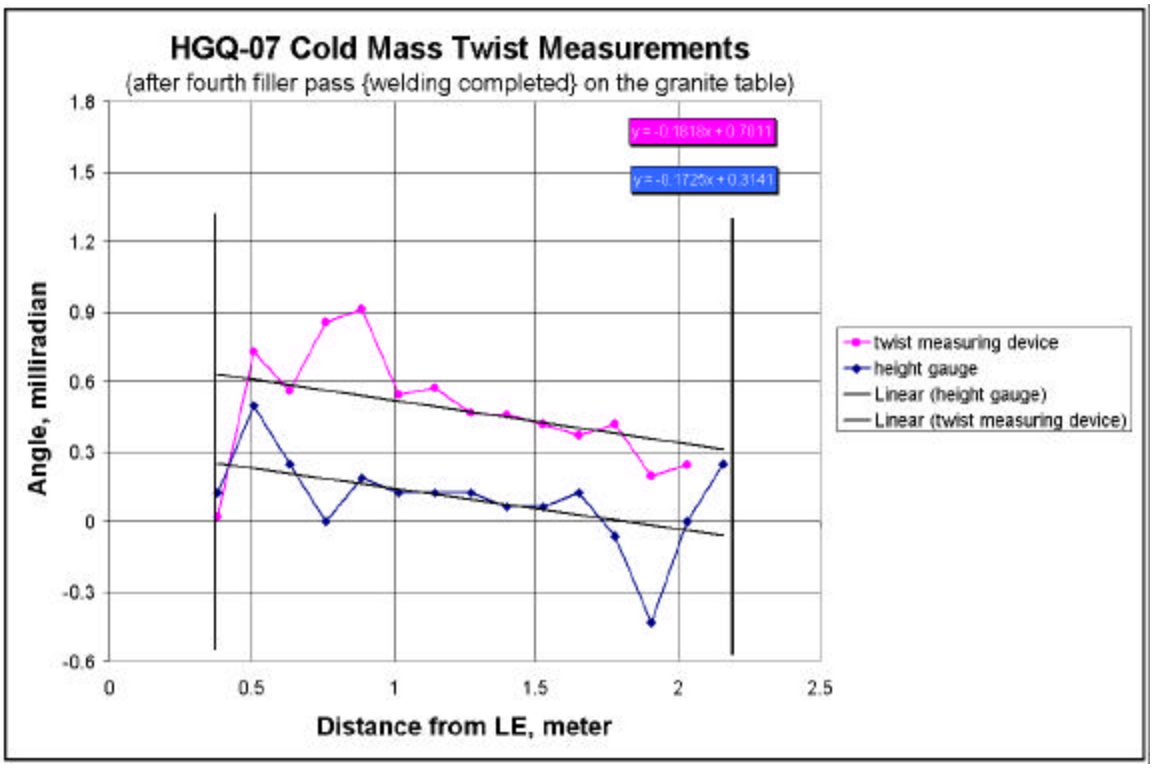
- Straightness of 2m model HGQ05, measured 4 times (each quadrant) around the perimeter. Data show no variation along the length of more that 25 microns.
- Measurements of the sag of 15m SSC dipoles, reported in 1991. Quick check of the data doesn't show any apparent straightness component in the measured values.

We will assemble the MQXB for yoke and skinning in the same press used for the 2m models and the SSC magnets. The press is specified and then checked to be straight to within 0.005", so at most with tolerance buildup I estimate it is true to within 0.010". We have not had any trouble placing the skins in the press during final assembly.

The final component which could affect straightness is the weld process, but this is an automative process in which the weld heads on both sides travel at the same position and feed rate, so we do not expect (nor have we seen in the past) straightness issues from this process.

Twist

Previously we have reported data such that the model magnets through HGQ06 were measured to have a mechanical twist of on the order of 1mrad/m. In a mechanical model produced after HGQ06, and magnet HGQ07, this number has been reduced to 0.18mrad/m.



The plot shows the measured mechanical twist of HGQ07, along the full length of the model magnet and skin ends. The 2-d section of the body of the magnet extends from x= 0.5m to 2.02 m on the plot. The remaining portions of the measurement are over the lead and return end cans of the magnet, where the skin alignment keys are not in direct correspondance with the coils, and so bear no relation to the magnetic twist.

Through magnet HGQ06, we have magnetically measured twists consistent with the mechanical twist, though because these are short models the measured body twist is calculated from only a few data points, and the introduction of the end field regions depending on the precise z-position of the probe can affect the accuracy of the measurements. In HGQ07 the magnetic data show a twist higher than the mechanical measurements, on the order of 1 mrad/m, but I do not see a mechanism for this to occur and after discussion with our measurement team we agree that for a short model this may be a limitation on the number of data points we want to sensibly take in a 1.4m straight section with a 0.8m length probe.

I think twist on the order of 0.2mrad/m is acheivable in the 5.5m MQXB.